

FEDERAL REPUBLIC OF GERMANY

DISCLOSURE NOTICE
DE 30 02 325 A 1

F 02 M 29/06

Notifier: Heim, Gerhard, 8000 Muenchen, DE

Device for Homogenization of a Fuel-Air Mixture

P a t e n t C l a i m s

1. Device for homogenization of a fuel-air mixture downstream of a carburetor for combustion power engine, comprising a dam nozzle and a rough surface. The dam nozzle is mountable in the suck pipe of the combustion power engine and fixable by means of a fixing flange between carburetor and suck pipe. The rough surface is arranged downstream of the dam nozzle and surrounding the mixture stream. The homogenization device is that way characterized, that a diffuser (14) is arranged between the dam nozzle (12) and the rough surface (30b, 38), the diameter of the diffuser is gradually widened to the inner diameter (D1) of the suck pipe and that the rough surface consists of several tongues (26) arranged in circumference direction side by side and with a distance one from the other, starting from the end edge of the diffuser (14) extending along the inner wall of the suck pipe under an acute angle (β) against the mantle line of the same, and that at least a part of their radial inward pointing surface is furnished with in the mixture stream projecting elevations (38).
2. Device according to claim 1, that way characterized, that the slope angle (β) between the tongue length direction and a mantle line of the suck pipe is ca. 20°.
3. Device according to claim 1 or 2, that way characterized, that the tongues (26) in their free section (30b) are twisted at least once about 180° around their length axis.
4. Device according to claim 3, that way characterized, that the twisting in each case extends evenly along the whole

with elevations (38) furnished section (30b) of the tongue (26).

5. Device according to claim 1 to 4, that way characterized, that the tongues (26) are formed as single-piece with the dam nozzle (12) and the diffuser (14).
6. Device according to claim 1 to 5, that way characterized, that the tongues (26) are made of flat profiles, that are inserted in on the outer circumference surface of a the dam nozzle (12) and the diffuser (14) forming ring body (10) formed length grooves (24) with a the thickness (C) of the tongues (26) corresponding to radial depth.
7. Device according to claim 6, that way characterized, that the upstream pointing ends (32) of the tongues (26) are bent radial outward and are laid in within the fixing flange (16) of the ring body (10) formed radial grooves (32) of thickness (C) of the tongues (26) corresponding axial depths.
8. Device according to claim 6 or 7, that way characterized, that the distances (a) between the length grooves (24) is at most about $\frac{1}{4}$ of the in circumference direction measured groove width (b).
9. Device according to one of claim 6 to 8, that way characterized, that the flat profile at least in the in length groove (24) lying region (30a) around its length axis are curved with a the outer radius of the ring body (10) corresponding curving radius.
10. Device according to claim 1 to 9, that way characterized, that the elevations on the tongue (26) are formed by sharp-edge teeth (38).

11. Device according to claim 10, that way characterized, that the teeth (38) are elevated ca. 0.3 to 0.5 mm above the tongue surface.
12. Device according to claim 10 or 11, that way characterized, that the tooth height (d) toward the free end (46) of the tongue (26) decreases.
13. Device according to claim 10 to 12, that way characterized, that the teeth (38) show an upstream pointing, essentially radial tooth flank (40) and a downstream pointing, at ca. 45° toward the tongue surface sloping tooth flank (42).
14. Device according to claim 10 to 13, that way characterized, that the teeth (38) of a tongue (26) are divided by at least a groove extending parallel to the length direction of the tongue (26).
15. Device according to claim 1 to 14, that way characterized, that the free ends (46) of the tongue (26) in each case show a transition rounding, which from the radial inward pointing tongue surface leads to the inner wall of the suck pipe.
16. Device according to claim 1 to 15, that way characterized, that the tongues (26) are made of metal.
17. Device according to claim 1 to 16, that way characterized, that the wall of the inlet section (20) of the dam nozzle (12) - viewed in a the axis containing section - is convex curved.
18. Device according to claim 17, that way characterized, that the axial measure (l_1) of the inlet section (20) is about the same as the difference of the inner diameter (D_1 , D_2)

of the suck pipe and the constricting section (22) of the dam nozzle (12).

19. Device according to claim 17 or 18, that way characterized, that the inner diameter (D_2) of the constricting section (22) is about 0.7 to 0.9 fold of the inner diameter (D_1) of the suck pipe.
20. Device according to claim 17 to 19, that way characterized, that the axial length (l_2) of the constricting section (22) is equal to the axial length (l_1) of the inlet section (20).
21. Device according to claim 17 to 20, that way characterized, that the opening angle (d) of the diffuser (14) following the constricting section (22), against the dam nozzle axis is about 5° to 8° .
22. Device according to claim 17 to 21, that way characterized, that the length of the free tongue section (30b) in each case is equal to 2.5 to 3 fold of the axial total measure of the inlet section (20) and the constricting section (22).

Patent Attorney
SCHAUMBURG, SCHULTZ-DOERLAM & THOENES
PERMITTED REPRESENTATOR FOR THE EUROPEAN PATENT OFFICE

Gerhard Heim

Balanstrasse 339
8000 Muenchen 90

Device for Homogenization of a Fuel-Air Mixture

The invention relates to a device for the homogenization of a fuel-air mixture downstream of a carburetor for combustion power engines, covering a dam nozzle mountable in a suck pipe of the combustion power engine and fixable by means of a fixing flange between the carburetor and the suck pipe, and a rough surface connected downstream the dam nozzle essentially enclosing the mixture stream.

It is known, that the quality of a by the fuel power engine sucked fuel-air mixture has significant influence on the performance, the fuel consumption and the pollutant emission of the combustion power engine. Basically it must be aimed to reach a possible uniform distribution of fuel and air. The mixture formation proceeds usually in the carburetor in the way, that the from a nozzle out-flowing liquid fuel in the stream of the by the combustion power engine sucked air is dispersed. The finer the fuel is dispersed usually the more uniform the fuel distribution in the fuel-air mixture.

The dispersion of the fuel proceeds in more or less big droplets, whereby the finer droplets are entrained in the center of the air stream, while the coarser droplets stay mainly in the slower layer of the air stream near the inner wall of the suck pipe. Thereby the fuel condenses on the usually cold suck pipe. The condensate can amount under circumstances up to 50% of the introduced fuel, so that the mixture is strongly leaned. The condensed fuel can be introduced into the cylinders of the combustion power engine not in equal parts, so that these cylinders receive different fuel-rich mixture.

There were already devices proposed, to undertake directly downstream of the carburetor a post dispersing of the fuel droplets and therewith to get a more uniform fuel-air mixture as well as to avoid a condensation of the fuel at the suck pipe. So it is known from the DE-AS 21 66 892 a device of at the beginning mentioned kind, by which the dam nozzle consists of a conical entry section and a cylindrical constricting section, whereby the rough surface is formed by the with an inner winding furnished wall of the cylindrical constricting section. This device has the disadvantage, that the stream at the end of the dam nozzle tears off and due to the distance between dam nozzle and suck pipe inner wall forms dead-space region.

Further it is for example from the DE-PS 820 820 a so called post-carburetor known, that consists of a in the suck pipe mountable ring with two tongue rims, where the in itself winding tongues of the first tongue rim lie essentially in a cross section plane of the suck pipe, while the longer and also in itself winding tongue of the downstream the first tongue rim laid second tongue rim sloping to suck pipe axis. With this device a better whirling of the mixture should be reached. Disadvantageous thereby is, that the mixture stream by the impact influence of the first tongue rim is too strong throttled.

The invention is based on the problem, a device of at the beginning mentioned kind so to be constructed, that a deposit of fuel at the suck pipe inner wall so far is avoided and a most possible homogeneous mixing of fuel and air is obtained, without that the mixture stream thereby essentially is throttled.

This problem according to the invention is solved that way, that between dam nozzle and rough surface a widening diffuser is arranged to gradually reaches the inner diameter of the suck pipe and that the rough surface comprises of a number of tongues, that are in circumference direction side by side and with a distance one from another that way arranged, that they extend starting from the end edge of the diffuser along the inner wall of the suck pipe under an acute angle against the mantle line of the same, and on at least a part of their radial inwards pointing faces furnished with projecting elevations.

The from the diffuser flowing out mixture is led against the tongue, whereby the fuel droplets in the outer mixture layer are broken at the elevations of the tongue. At the same time the mixture stream through the arrangement of the tongue receives spin movement, through which the outer mixture layer is guided toward the suck pipe axis and a deposit of fuel at the suck pipe inner wall shall be avoided. The sloping angle between the tongue length direction and a mantle line of the suck pipe can be ca. 20° .

The tongues are preferably twisted in their free section at least once about 180° around their length axis. That way, a swirling of the mixture is achieved in the edge layer of the mixture stream. The in the elevations of the tongues broken down liquid droplets are guided toward the suck pipe axis.

The elevations on the tongue are preferably formed by sharp-edge teeth, which are elevated for example 0.3 to 0.5 mm above

the tongue surface. The tooth height can decrease toward the free end of the tongue. An effective breaking-down of the liquid droplets is that way achieved, that the teeth are upstream pointing, essentially radial tooth flank and a downstream pointing, of ca. 45° toward the tongue plate sloped tooth flank. The teeth of a tongue can be divided by at least a groove extending parallel to the length direction of the tongue, so that additional angles and edges are formed to break down the liquid droplets. At the same time the grooves act also as spin trains, which care for a turbulence of the mixture stream.

In order to avoid the further going formation of end turbulence at the free ends of the tongues, the free ends of the tongues preferably furnished with a transition rounding, that leads from the radial inwards pointing tongue plate to inner wall of the suck pipe.

The tongues can be formed as one-piece with the dam nozzle and the diffuser. As an example, can the dam nozzle, diffuser and tongues be made of synthetic material parts. Suitable synthetic materials are for example polyamide or polyterephthalicacidester.

The tongues can however also be made of individual flat profiles, that in at the circumference surface of a the dam nozzle and the diffuser forming ring body formed length grooves of a thickness of the tongues corresponding radial thickness. In this case the tongues can consist of metal, while the ring body can be made of synthetic material, steel, a non-iron metal or a combination of the former said

materials. To set the tongue in axial direction, the upstream pointing ends of the tongues in a preferable implementation form are bent to radial outward direction and placed in the radial grooves of thickness of the tongues that is prepared in the fixing flange of the ring body. The distances between the length grooves should be at most about $\frac{1}{4}$ of the in circumference direction measured groove width. To maintain a close seat of the ring body and the tongues in the suck pipe, the plate profiles are curved at least in the length groove lying region around its length axis with an outer radius of the ring body appropriate curvature radius. There are preferably ca. eight tongues symmetrically distributed around the circumference of the ring body.

The wall of the inlet section of the dam nozzle is by a preferable implementation form of the invention - viewed in a the axis containing section - convex curved, whereby the axial measurement of the inlet section is about double so large as the difference of the inner radius between the suck pipe and the constricting section of the dam nozzle. It shows thereby, that the best result is achieved, if the inner diameter of the constricting section is about 0.7 to 0.9 fold of the inner diameter of the suck pipe. The axial length of the constricting section of the dam nozzle is preferably equal to the axial length of the inlet section.

The opening angle of the diffuser must be so selected, that the stream can not tear off. This is guaranteed, if the opening angle of to the constricting section following diffuser against the dam nozzle axis is about 5° to 8° .

The length of the free tongue section is preferably about $2\frac{1}{2}$ to 3 fold of the axial total measure of the dam nozzle.

The invention conforming device causes, through post-dispersing of the fuel droplets in the carburetor, leaving mixture a further approach to the stoichiometric air-fuel ratio, so that at a given performance of the combustion power engine not only the fuel consumption but also the pollutant emission can be reduced. The invention conforming device can be mounted in the combustion power engine not only serially but also supplementary later on. The device is simple and low-priced to produce and can also be mounted by every technically talented non-specialist.

Further characteristics and advantages of the invention will be shown in the following description, which describes the invention by means of an implementation example that relates to the attached figures. It shows:

Fig.1 a perspective partial schematic view of the invention conforming device, whereby however, only two of the tongues are indicated,

Fig.2 a section along line II-II in Fig.1,

Fig.3 a view of a not yet twisted tongue alone,

Fig.4 a section along line IV-IV in Fig.3 and

Fig.5 a of the Fig.4 related section through the upper section of a tongue in magnified measure.

The in Fig.1 shown invention conforming device to post-dispersing of fuel comprises a generally with 10 marked cylindrical ring body, which contains a dam nozzle 12 and a diffuser 14. The ring body 10 is mounted in the suck pipe of a combustion power engine and by means of a flange 16 and appropriate not shown packing is fixed between the outlet opening of the carburetor and the inlet opening of the suck pipe. For this the flange is furnished with drill holes 18 for passing of binding screw. The ring body 10 is also placed that way in the suck pipe, that the from the carburetor flowing-out fuel-air mixture flows through the ring body 10 in the direction of the arrow A in Fig.2.

The outer diameter D_1 of the ring body 10 is essentially equal to the inner diameter of the suck pipe. As already mentioned above, the ring body 10 comprises the dam nozzle 12 and the diffuser 14. The dam nozzle 12 consists of a in the section convex curved funnel-form inlet section 20 and a cylindrical constricting section 22. The inner diameter D_2 of the cylindrical inlet section 22 is about 0.7 to 0.9 fold of the inner diameter of the suck pipe D_1 . The axial expansion l_1 of the in the section circle-arc-form curved inlet section 20 of the dam nozzle 12 is about equal to the difference of the inner diameter D_1 of the suck pipe and the inner diameter D_2 of the constricting section. The axial length l_2 of the constricting section 22 is about equal to the length l_1 of the inlet section 20.

The at the dam nozzle 12 downstream of it connecting diffuser 14 widens the stream cross section in the constricting section 22 again to the stream cross section of the suck pipe. The

opening angle α of the diffuser inner wall against the axis of the ring body 10 is preferably about 5° to 10° .

The ring body 10 shows on its outer circumference surface grooves 24, that serve for reception of tongues 26, that is shown in Fig.3 and 4 and their attachment position slashed indicated in Fig.1. The angle β between a mantel line of the ring body 10 and the length direction of groove 24 is ca. 20° . At the shown implementation example are eight grooves 24 along the circumference of the ring body 10 that way distributed, that the in circumference direction measured width a of the bridge 28 between two grooves 24 is about $\frac{1}{4}$ of the in circumference direction measured width b of a groove.

The tongue 26 consists of in the present implementation example a flat profile strips with a longer section 30 and a rectangular to this bent shorter section 32. The shorter section 32 is thereby so bent, that the longer length edge of the longer section 30 with the weight on the shorter section 32 forms the angel β . So the tongue 26 with the longer section 30 can be laid in the respective groove 24, while the shorter section 32 is laid in the groove 34, which is formed on the to the carburetor pointing site of the flange 16 in each case connecting to a groove 24. At the transition between the cylindrical part of the ring body 10 and the flange 16 shows the latter in each case a slit 36, which in each case a groove 24 connected with the respective groove 34. The depth of the groove 24 and the groove 34 is equal to the material thickness c (Fig.4) of the tongue 26 forming profile strip. The width of the profile strip corresponds also the width b of the nut 24 and the nut 34, so that the in the

grooves 24 and 34 laid tongue 26 the grooves 24 and 34 in each case completely filled up. In order also to obtain, by inserted tongue 26, a closed smooth outer circumference surface of the cylindrical parts of the ring body 10, the tongues 26 are in the directly at the section 32 connecting part 30a of the longer tongue section 30 so bent, that they nestle against the groove ground of the respective groove 24.

In the at the part 30a adjacent part 30b of the longer tongue section 30 the tongue on its both sides of the flat profile is furnished with a number of sharp-edge teeth 38. The teeth are shown in Fig.5 a bit exaggerated. The teeth 38 show in each case a rectangular to the tongue surface extending tooth flank 40, that in the mounted state of the tongue upstream pointing, while the downstream pointing tooth flank 42 forms an angle of about 45° with the first tooth flank 40. The tooth height d is about between 0.3 to 0.5 mm. Near the free end of the tongue 26 the tooth height decreases continually, as it is indicated in Fig.5. The teeth 38 are arranged one upon the other in a number of tooth rows, whereby the tooth rows are subdivided by at least one parallel to length direction of the respective tongue 26 extending tooth-free channel 44 (Fig.3). Thereby the number of the sharp edges on the teeth is increased. Further the channels 44 serve for guiding of mixture stream. The width of this groove 44 should not pass over 1 mm.

The total length of the section 30b of the tongue 26 is about $2 \frac{1}{2}$ to 3 folds of the length of the dam nozzle 12, that is the sum of the distance l_1 and l_2 . In the Fig.3 to 5 it can be seen, that the teeth 38 are not extended up to the end of the

tongue 26. On the contrary an end section 46 of the tongue 26, the length of which is about $1/5$ of the total length of the section 30b, smooth prepared. At the to the bent shorter section 32 of the tongue 26 pointing side shows the end section 46 a transition rounding, the radius of which is about equal to the material thickness of the tongue 26.

After the tongues 26 are inserted in the grooves 24 and 34, in each case the above the ring body 10 protruding section 30b of the tongues 26 equally once twisted around 180° . As we can see, the free end of the tongue 26 lies then so, that the transition rounding in the section 46 points to the wall of the suck pipe.

The in the suck pipe of the combustion power engine downstream the carburetor mounted invention conforming device effects in the operation, that the from the carburetor coming mixture in the dam nozzle 12 first of all is accelerated, whereby the at the edge layer located larger fuel droplets are accelerated to the dam nozzle axis. The from the diffuser 14 coming mixture hits then the teeth 38 of the tongue 26, whereby the fuel droplets at the teeth 38 are broken down. At the same time the mixture receives a momentum by the spiral arrangement of the tongues. The twisting of the individual tongue gives rise to an additional turbulence of the mixture in the edge regions of the mixture stream. That way the usually in the outer layer of the fuel stream located fuel droplets are forced by turbulence to the center and a better distribution of the fuel within the fuel-air mixture is obtained as well as a deposit of the fuel at the inner wall of the suck pipe is avoided.

The whole device can be of course also so executed, that it is prepared as single-piece of synthetic material, whereby the tongue, that is the in the present example with 30b marked section are formed directly on the ring body 10. The grooves 24 and 34 can then be omitted.